Results from the Mauna Loa Ultrahigh Resolution Infrared Solar Spectrometer

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INTRODUCTION

The Network for Detection of Stratospheric Change (NDSC) ultrahigh resolution infrared solar spectrometer system continued operation in 1993 with only minor problems. The instrument and data analysis technique were described in the 1991 Summary Report [*Ferguson and Rosson, 1992*]. The instrument is operated once per week (usually Wednesdays) at sunrise by the MLO staff. The spectra cover two regions: 750 to 1250 cm^{-1} (8 to 13 μm) and 2500 to 3100 cm^{-1} (3.1 to 4 μm). University of Denver personnel visited the site three times during the year to make special measurements and carry out adjustments.

The spectrometer system began routine operation in November, 1991, so we now have 2 years of data. This is sufficient to begin the study of seasonal cycles and trends.

RESULTS AND DISCUSSION

We are currently analyzing the infrared spectra for total column amounts of several gases. In some cases, altitude information can also be recovered. Although this instrument is intended primarily for monitoring of stratospheric chemistry, many tropospheric gases are also observed. An example of this is ethane (C_2H_6). Ethane is released from the surface in a variety of processes, some of them related to human activity. Destruction of ethane in the troposphere is due to oxidation by OH radicals. The ethane concentration falls off rapidly in the stratosphere. This, coupled with the high tropopause over MLO, means that total column amounts measured by infrared solar absorption spectra are almost entirely tropospheric.

Spectra were analyzed for the vertical column amount of ethane using an absorption feature at 2976.77 cm^{-1}. An example spectrum and a fit are shown in Figure 1. The spectral fitting routine adjusts several parameters, including amounts of interfering gases like ozone and methane. Spectra from 71 days have been processed, and the results are shown in Figure 2. The seasonal effect is expected, and the model prediction of *Kanakidou et al.* [1991] is shown on the figure for 3 months.

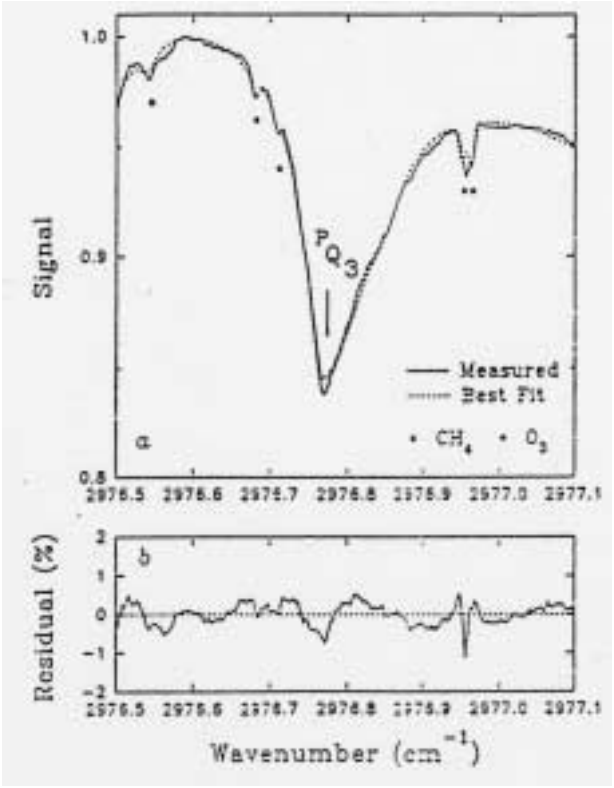

Fig. 1. A small section of an infrared solar absorption spectrum is shown in the top panel (dotted line) along with the best fit modeled spectrum (solid line). The absorption marked P_{Q3} is due to ethane, the smaller features are methane or ozone as indicated. The bottom panel shows the experimental spectrum minus the calculated on an expanded scale.

HNO_3 is one of the stratospheric gases that is routinely monitored. The total vertical column of HNO_3 over the period from November 1991 to October 1993 is shown in Figure 3. Mount Pinatubo erupted in July 1991, shortly before routine operation of the instrument began. Also shown in the figure is the aerosol loading of the stratosphere (as observed by the SAGE satellite) during the same period. The effect of the Mount Pinatubo aerosol on the HNO_3 column is clear, indicating that significant reactions are occurring on the aerosol surface. We also show the ozone

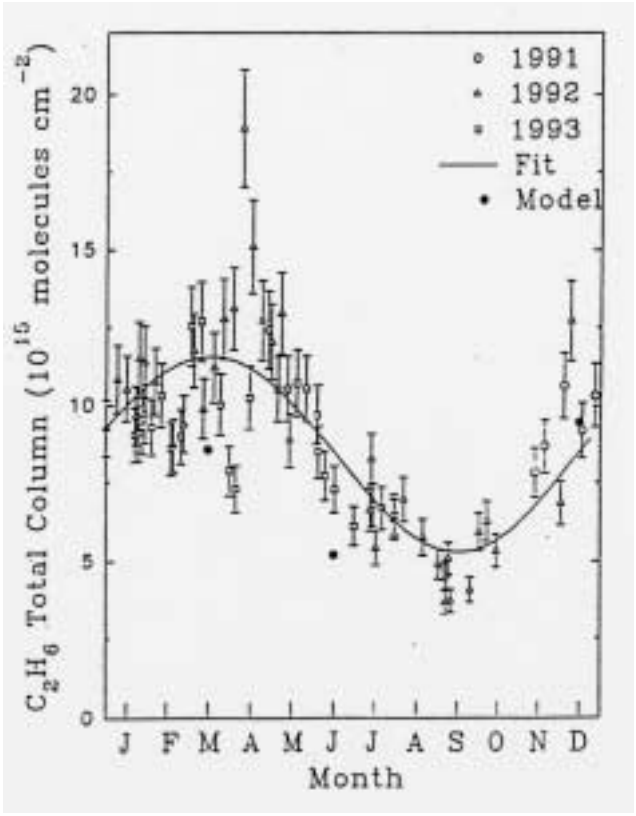

Fig. 2. Vertical column amounts of ethane determined from the infrared spectra. Error bars show the random component of uncertainties in the measurement. The best fit curve (solid line) is a cosine with amplitude 0.37 and maximum in mid-March, added to the average column of 8.44×10^{15}. Model values are from *Kanakidou et al.*, 1991.

amount in this figure to indicate that no large change in ozone column occurred, although our data is not sufficient to determine small changes. The observed change in HNO_3 agrees well with similar observations from New Zealand [*Koike et al.*, 1994].

Continued operation of the instrument is planned for next year.

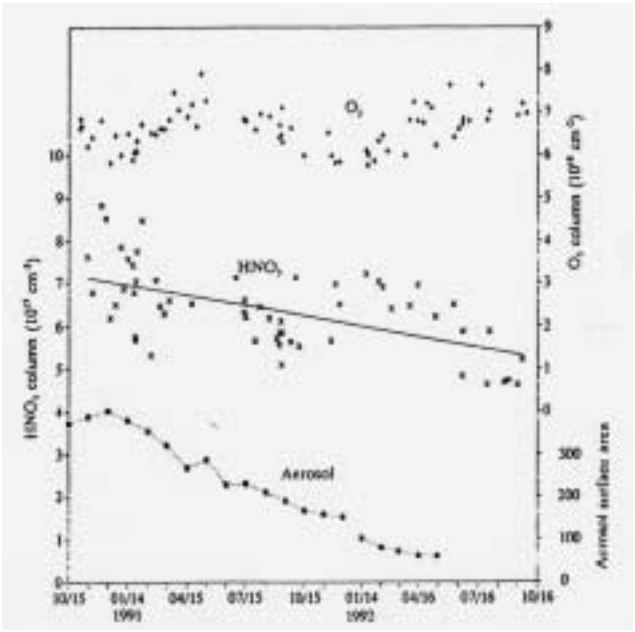

Fig. 3. Vertical column amounts of ozone and HNO_3 over MLO, along with the monthly mean total aerosol loading ($\mu m^2 km/cm^3$) observed by SAGE in the 15 to 35 km region between 10°N and 20°N. The solid line through the HNO_3 values has a slope of 15% per year.

Acknowledgments. We continue to be particularly grateful to the MLO staff for the dedication and skill in operating our instrument.

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